



PHYTOCHEMICAL SCREENING AND EVALUATION OF ANTIBACTERIAL ACTIVITY OF DIFFERENT EXTRACTS OF *SOLANUM TORVUM* (SUNDAKKAI) FRUITS AGAINST HUMAN PATHOGENIC BACTERIA

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ABSTRACT

Solanum torvum (Sundakkai), commonly known as Turkey berry, is a traditionally used medicinal and nutritional plant belonging to the family Solanaceae. The present study was undertaken to investigate the phytochemical constituents and antibacterial activity of different extracts prepared from the fruits of *S. torvum*. Dried fruits were extracted using different solvents, including petroleum ether, acetone, ethanol, and water. The extracts were evaluated for antibacterial activity against human pathogenic bacteria such as *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus* species using the agar well/disc diffusion method. The results demonstrated that the extracts exhibited antibacterial activity against the tested bacterial strains, with activity varying according to the solvent and concentration used. Among the tested extracts, acetone and petroleum ether extracts showed comparatively higher antibacterial activity, particularly at a concentration of 50 mg. Phytochemical screening revealed the presence of important bioactive constituents, including alkaloids, tannins, phenolic compounds, flavonoids, carbohydrates, amino acids, fixed oils, glycosides, and terpenoids in different extracts. Thin-layer chromatography was further used for preliminary separation of bioactive constituents, while mass spectrometric analysis indicated the presence of several metabolites, including flavonoids, alkaloids, and chlorogenic acid-related compounds. The findings support the traditional medicinal importance of *S. torvum* and indicate that its fruits may serve as a potential natural source of antibacterial compounds. Further investigation and isolation of individual bioactive compounds may help in the development of plant-based antimicrobial agents.

KEYWORDS: *Solanum torvum*, Sundakkai, Turkey berry, Phytochemical screening, Antibacterial activity, Human pathogens, Alkaloids, Flavonoids, Phenolic compounds, Antimicrobial agents.

INTRODUCTION

Solanum torvum- Turkey Berry in English, Sundakkai in Tamil is a common and easily available vegetable. A Turkey Berry fruit actually has the outer skin inside of which lies the pea aubergine seeds. Turkey Berry is called by different names like the prickly nightshade,

shoo-shoo bush, wild eggplant, pea eggplant, thai egg, plant and many other names. In the southern part of India, people consume the young fruit and sundakkai vathal or dried turkey berry are used as food in the form of various dishes frequently intake.



S. torvum-plant parts have medicinal properties, it helps in healing and prevention of cold & flu asthma, lung, inflammation, cough etc., helps in treating kidney related issues by reversing the process of tubular necrosis and glomerular congestions. It has rich in Iron which is extremely beneficial for treating anaemia. Regular consumption of Turkey berry would help to increase the count of blood cells and reduce the anaemia. Turkey berry contains antioxidants like flavonoids, glycosides, saponins, torvosides, tannins, alkaloids, chlorogenome, etc. Thus, pea eggplant helps to prevent strokes, cancer, and cardiovascular diseases. When blood sugar level is too high, it becomes a life-threatening condition which is commonly known as diabetes. Dried berry leaves & turkey berry help to control diabetes. It is said to have properties that help in maintaining and regulating the blood sugar level. Turkey berries can neutralize the acidic of the stomach and healing for gastric ulcers and stomach related problems and also prevent the development of intestinal worms. Turkey berries have antibacterial and anti-fungal properties that can stop the excessive cell growth thus making it significant for cancer. The extracts of turkey berry (Sundakkai) are helpful in protection against lung cancer. Regular consumption of this berry helps in aiding regular menstrual periods. Include turkey berries to your regular diet to solve all kinds of menstrual issues. Uric acid is the reason behind pain, redness, and symptoms of gout. These berries help to flush out uric acid thus helps to reduce pain, redness, and symptoms of gout. Berry leaves are a good source of natural steroids called soasoline and inflammatory agents that are great for arthritis, lower back pain, and swelling. The berry leaves can be used to treat skin diseases like pimples and sores.

So *S.torvum* is used as Analgesic, antipyretic, anti-rheumatic, anti-infectious, diuretic, anti-contusion, anti-inflammation, and antiphylogistic. So the traditional medicine practitioners are using *S. torvum* in siddha and ayurvedic medicine to prevent and control for various diseases.

A critical literature survey revealed that antimicrobial activity of *S. torvum* against *E.coli*. Hence the present study aimed at exploring this neglected plant. Different solvent extracts of *S. torvum* fruits at different concentrations were checked for the antimicrobial activity against disease causing microorganisms and identification of active compound have antimicrobial activity. The following objectives are

- To extract the compounds from dried fruits of *S. torvum* in different solvents such as hexane, petroleum ether, chloroform, water and methanol
- To test the extracts for antimicrobial activity against human pathogens
- Identification of active compounds through biochemical test against with human pathogens.

2. Review of literature

Solanum (Sundakkai)- A PROMISING BOTANICAL

Solanum sp is one of the traditional medicinal plants (Whistler, 1985) that grow as a small evergreen tree in all regions. It has been used for over 2000 years in Polynesia and has a broad range of therapeutic and nutritional value the roots, stem, leaves, flowers and fruits are used in various combinations as herbal remedies. Extracts from fruits extract of *S. exhibited* moderate anti-bacterial property against *E.coli* and

Salmonella sp. (Bushnell *et al.*, 1980). Further it has a number of biologically active components: 23 phytochemicals, 5 vitamins and 3 minerals. This study showed growth inhibition of human pathogens in dose-dependent manner.

S. torvum Fruits - The fruits are berries that are yellow when fully ripe. They are thin-fleshed and contain numerous flat, round, brown seeds. Seeds - Seeds numerous, drab brownish, flattened, discoid, 1.5-2 mm long slightly reticulate, Self-compatible, Odour - Pepper-like.

Solanum torvum exhibits pharmacological effects as sedative and diuretic (Loganayaki *et al.*, 2010). The fruit decoction is used in cough, liver and spleen enlargement and as hemopoetic tonic. This plant is commonly used in Asian, African and Tropical American traditional medicine in blood stasis, menstruation, edema pain and coughs. A decoction of fruits is given for cough ailments and is considered useful in cases of liver and spleen enlargement (Siemonsma J, Piluek K 1994). The ripened fruits are used in the preparation of tonic and haemopoietic agents and also for the treatment for pain (Kala 2005). It has antioxidant properties (Sivapriya and Srinivas 2007). It is intensively used worldwide in the traditional medicine as poison anti-dote and for the treatment of fever, wounds, tooth decay, reproductive problems. Israf *et al.*, 2004 reported that *S. torvum* also possesses Antimicrobial Antiviral, Immuno-secretory, Antioxidant, Analgesic and Anti-inflammatory, Anti-ulcerogenic activities, Cardiovascular, Nephroprotective, Antidiabetic (Gandhi *et al* 2011), Angiotensin and Serotonin receptor blocking activities. The *Solanum torvum* fruit has been reported to be rich in protein, fiber, calcium, magnesium, iron, vitamin A, B-complex and C. The per hundred gram of young fruit contains 85.4 g water, 2.4 g protein, 0.4 g fat, 10.7 g carbohydrate, 6.1 g fiber, 104 mg Ca, 70 mg P, 4.6 mg Fe, 390 µg β-carotene, 0.12 mg Thiamin, 0.09 mg riboflavin, 2.6 mg niacin and 4 mg ascorbic acid. The total energy available per 100 g of fruit is 47 Kcal.

Phytochemical screening of methanolic extract of *S. torvum* fruits gave positive tests for alkaloids, flavonoids, saponins, tannins, glycosides, fixed oil, vitamin B group, vitamin C and iron salts (Israf *et al.*, 2004). It also has number of chemical constituents like neochlorogenin 6-O-β-D-quinovo-pyranoside, neochlorogenin 6-O-β-D-xylopyranosyl-(1→3)β-D-quinovopyranoside neochlorogenin 6-O-α-L- rhamnopyranosyl-(1→3)-β-D-quinovopyranosid, sola-genin 6-O-β-D-quinovopyranoside (Lu *et al* 2009) solagenin 6-O-α-L-rhamnopyranosyl-(1→3)-β-D-quinovopyranoside, isoquercetin, rutin, kaempferol and quercetin (Waghulde *et al* 2011). Recently studies reveal that its flavonoid content is mainly responsible for its Antioxidant, Antihypertensive, Metabolic correction and Nephroprotective activities.

creening of phytochemicals from the fruits of *Solanum torvum* by GC-MS study showed 12 different types of active constituents like volatile oils, phenolic, alkaloids, flavonoid, acidic compounds, palmitic and oleic acid etc. Oleic acid is known with pronounced antimicrobial properties and it has been shown to exhibit antimicrobial activity against *Staphylococcus aureus* and *Micrococcus kristinae* (Sarmiento de Silva and De Carvelbo M.G 2003). Benzene ethanamine, Phytol was the diterpene compound and Octadecanoic acid was the stearic acid compound were found in the extract at R_t 19.92 and 20.63 respectively. These compounds are among those which are reported to have antimicrobial, anti-inflammatory, anti-fatigue, hypo cholesterolemic, nematocide, antiandrogenic, anticancer and hemolytic activities (Wollen Weher *et al* 2005).

The methanolic extracts of fruits and leaves were reported to have antimicrobial activities against human and animal clinical isolates (Chah *et al.*, 2000). The plant extract have been reported to be antibacterial against *E.Coli*, *V. cholera* *S.aureus*, *B. subtilis*, *S.cibrium*, *S. typhimurium* and *Pseudomonas* sp. (Sivapriya *et al.*, 2011; Lakshmi *et al.*, 2013). Aqueous extracts from the various parts of *S. torvum* exhibit potential anti-inflammatory and analgesic properties (Ndebia *et al.*, 2007). Berries few are 10 in clusters, drab yellow, brownish at maturity. The antibacterial activity was expressed at varying concentration and dose dependent. The various concentration of (100%, 80%, 60%, 40%, 20%) methanol extracts of showed significant activity against all the bacteria tested. The methanol extract of *Solanum* leaves which showed activity against all bacterial species tested at all the dosages (Kannan *et al* 2012). Antiviral isoflavonoid sulfate and steroidal glycosides were also isolated from the fruits of *S. torvum*. Arthan *et al.*, 2002 investigated MeOH extracts of fruit and found one new isoflavonoid sulfate named as torvanol A, and a new steroidal glycoside, named torvoside H, together with the already-known glycoside, torvoside A.

3. MATERIALS AND METHODS

3.1 Glassware / Plastic ware and Chemicals

Materials

S. torvum Fruits – 100 gms

Extraction solvents

Water- 1.0 lit

Acetone- 1.0 Lit

Petroleum ether- 1.0 lit

Ethyl Alcohol (Ethanol) – 1.0 lit

Equipments

Soxhlet Apparatus

Thin Layer Chromatography

Mass spectrometer

Glassware, microdips and eppendroff tubes (Borosil, Tarson and Dia-Lab brands) were initially cleaned with detergent, and immersed in chromic acid cleaning

solution overnight, washed thoroughly with tap water, rinsed with distilled water and dried in a hot air oven. Analytical grade chemicals (Himedia / Merck/ Qualigens) were used. Media and glassware used in the study were autoclaved at 120° C under 15 lbs pressure for 15 min.

METHODOLOGY

Dried *Solanum torvum* fruits- making Method:

The fruits of *S. torvum* collected from home garden and agriculture fields near Madurai. Wash the turkey berry

fruits in water green colour of the vegetable changes, take it out. Spread it out in a clean cloth or in a plastic paper. Allow the pea eggplant seeds to dry completely on Sun. Allow the same procedure for the next 3 to 4 days until the pea aubergine seeds get completely dried. Finally, the dried *Solanum torvum* fruits is ready for use. Store the dried turkey berry in an airtight container.



Extraction of plant material

500 gms of dried fruits was grind using mixer grinder and used for extraction. 10 gm of *S. torvum* fruits powder mixed with 100 mL of distilled water, ethanol, Petroleum ether and acetone separately. The resultant solution was vortexed thoroughly for 15 min and kept overnight at 4°C. The resultant suspension was frozen and thawed, centrifuged for 20 min at 4°C and 10,000 rpm. The water extract was lyophilized at -37°C and referred to as WE (Water Extract of *S. torvum* coat). The Ethanol: Water (1: 1) extract was evaporated at 37°C till the alcohol gets evaporated and the remaining water was lyophilized at -37°C and referred to as EWE (Ethanol Water Extract (1:1) of *S. torvum* coat). Similarly, ethanol extract, hexane extract and acetone extract were concentrated

separately by evaporating at 37°C to a brown residue are referred as EE (Ethanol Extract of *S. torvum* coat), HE (Hexane Extract of *S. torvum* coat) and AE (Acetone Extract of *S. torvum* coat). Ten milligram of each concentrated dried extract was dissolved in 1.0 mL of corresponding solvent or solvent mixtures and mixed. The solution was filtered in 0.45 micron microbial filter and stored at -20°C for further studies. The standard antibiotics were used at the concentrations based on the normal dose given for the infection.

Microbial strains: Authentic pure clinical isolated cultures of human pathogenic bacteria, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus* sp, were obtained from Bose Clinical Lab, Madurai.

Agar well diffusion method

Antibacterial activity of various extracts of *S. torvum* coat was evaluated by the well diffusion method on nutrient agar medium (Forbes et al., 1990). This was confirmed by the inhibitory effect on bacterial growth as reflected by the inhibited zone compared to known antibiotics. The sterile nutrient agar medium (20 mL) in petri plates was uniformly smeared using sterile cotton swabs with test pure cultures of *E. coli*, *Streptococcus* sp, *S. aureus*. The nutrient agar media was prepared by dissolving 0.3 beef extract, 0.3 yeast extract, 0.5 peptone, 0.5 NaCl and 1.5% agar in 1 liter of distilled water. The Whatman No 1 paper cut into small discs and soaked with various extracts of *S. torvum* fruits. Then 2-4 discs are placed in the petri plates. For each treatment three replicates were maintained. The diameter of the zone of inhibitions was measured in millimetres after 24 h.

TEST FOR ALKOLOIDS

The extracts of *S. torvum* was subjected to various colour reaction to identify the nature of the components.

A) DRAGENDROFF'S TEST

2.0 ml of *S. torvum* various extract and added 2.0 ml of dragendroff's reagent and observed the colour.

B) MAYER'S TEST

2.0 ml of *S. torvum* various extract added 2.0 ml drops of Mayer's reagent and observed the colour of the precipitation.

TEST FOR TANNINS AND PHENOLIC COMPOUNDS

The various extracts were tested with various reagents to detect the presence of Tannin and Phenolic compounds, 2.0 ml of *S. torvum* various extract added 2.0 ml drops of Ferric chloride solution and observed the colour of the precipitation and add two drops of Lead acetate solution two drops of Gelatin solution and 1.0 ml of Bromine water tested in respectively.

TEST FOR CARBOHYDRATES

a. Molish's Test

Added 2-3 drops of Molisch's reagent (5% naphthol in Ethanol) to 2.0 ml of *S. torvum* extract. Gently pipette 1ml conc. H₂SO₄ along the side of the tube so that two distinct layers are formed. Distilled water in another tube as control Observed the colour change at the junction of two layers.

B. Benidict's test

2.0 ml of *S. torvum* extract was treated with 5 drops of Benedicts reagent and heated over a boiling water bath for 5mins. Observed the appearance of colour.

C. Fehling's Test

2.0ml of *S. torvum* extract was treated with 1.0 ml of each fehling's 1 and 2 solution and heated over a boiling water bath for half an hour. Observed the appearance of the colour.

Test for Flavonoids

Shinoda Test- Pieces of Magnesium ribbon and HCl concentrated were mixed with 2.0 ml of *S. torvum* extract after few minutes and observed the colour and based on the colour the presence of flavonoid was confirmed.

Alkaline Reagent Test. 2 ml of 2.0% NaOH mixture was mixed with 2.0 ml of extract; concentrated yellow colour was produced, which became colourless when we added 2 drops of diluted acid to mixture. This result showed the presence of flavonoids.

TEST FOR AMINO ACIDS

A. Ninhydrin test

The *S. torvum* extract was heated with 5% Ninhydrin solution on boiling water bath for 10 minutes.

B. Million's test

Millon's reagent is an analytical reagent used to detect the presence of soluble proteins. A few drops of the reagent are added to the 2.0 ml *S. torvum* extract, which is then heated gently. Based on the appearance of colour the Trysine amino acid to be confirmed.

TEST FOR STEROIDS

A. Libermann- burchard test

Added the 2ml of *S. torvum* extract with Chloroform solution, a few drops of Acetic anhydride and 1 ml of concentrated Sulphuric acid are added through the sides of the test tube and set aside for a while. Based on the appearance of colour the steroids confirmed.

B. Salkowski test

2.0 ml of *S. torvum* extract added with Chloroform solution, a few drops of concentrated Sulphuric acid is added, shaken and allowed to stand. Appearance of colour was observed.

C. Libermann's reaction

Mix 2.0 ml of *S. torvum* extract with 3ml of Acetic anhydride, heat and cool a few drops of concentrated Sulphuric acid are added. Appearance of color indicates the presence of steroids.

TEST FOR GLYCOSIDES

A. Borntrager's test

Mix 2.0 ml of *S. torvum* extract with dilute Sulphuric acid filtered, cooled and the filtrate was extracted with little Chloroform layer is separated out add equal volume of dilute Ammonia. Based on the change of pink to red color in Ammonical layer indicates the presence and absence of Anthraquinone glycosides.

B. Modified Borntrager's test

2.0 ml of *S. torvum* extract was boiled for 2 minutes with dilute HCl filtered while hot and cooled. The filtrate was then extracted with Benzene and it is separated. Equal volumes of dilute Ammonia solution is added to the Benzene extract and shaken well. Based on the change of rose pink to cherry red color is observed in the Ammonia

layer indicates the presence and absence of Anthroquinone glycosides.

C. Legal's test

2.0 ml of *S. torvum* extract was dissolved in Pyridine and Sodium nitro prusside solution and made into alkaline. The appearance of the colour was observed.

D. Baljet test

2.0 ml of *S. torvum* extract was treated with sodium picrate solution. The appearance of the colour was observed.

TEST FOR SAPONIN GLYCOSIDES

Shake the 2ml of *S. torvum* extract with 5.0 ml of water. Formation of foam indicates the presence of Saponin glycosides.

Test for Terpenoids

2.0 ml of *S. torvum* extract was treated with little chloroform solution was warmed with tin and Thionyl

chloride. Appearance of pink colour indicates the presence of Terpenoids.

Determination of Minimum Inhibitory Concentration (MIC)

The minimum inhibitory concentration of different extracts of *S. torvum* fruit coat (Karou et al., 2005).

Thin layer chromatography

The Acetone extract was used for TLC study. The organic phase is separated from the acidified filtrate and basified with NH_4OH (pH 11-12). It is extracted with chloroform (3x), condensed by evaporation and used for chromatography. The alkaloid spots were separated using the solvent mixture chloroform and methanol (15:1). The colour and R_F value of the separated alkaloids were recorded both under Ultra Violet (UV 254nm) and visible light after spraying with Dragendorff's reagent.

Separation and purification of the bioactive compound

In the present study, Acetone extract of *S. torvum* was fractionated in the SiO_2 column (60-120 mesh size) column using different solvent combination. The details are as follows.

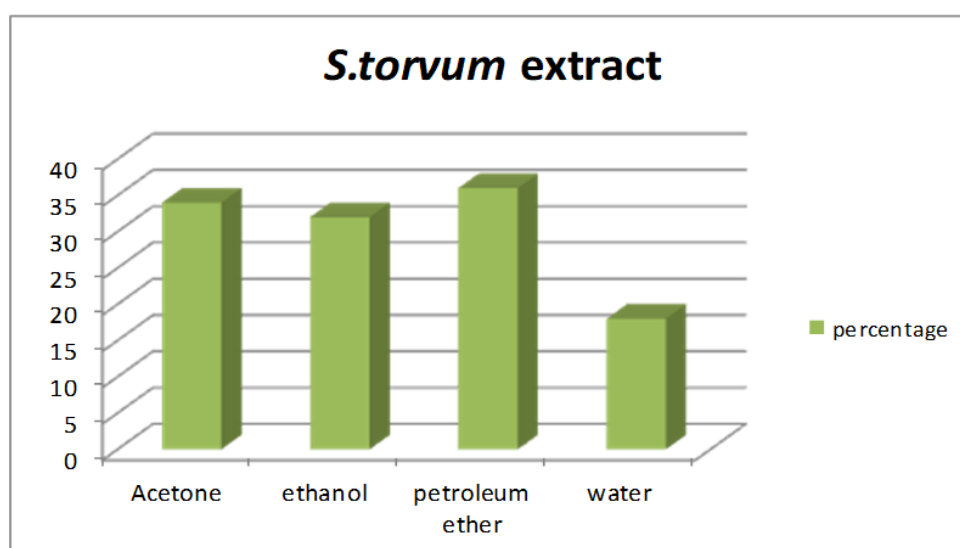
Plant extract	Solvent used	Fractions eluted (Nos)
<i>S. torvum</i> - methanol	hexane : ethyl acetate (9:1)	3

The MS was configured to scan the range of 100–1000 Da with a scan time of 0.2 s. After series of optimization, the following settings were found to be optimal: capillary voltage of 2.5 kV, sample cone potential of 30 V, source temperature of 120°C, desolvation temperature of 450°C, cone gas flow of 50 L/h and desolvation gas flow of 550 L/h, and multichannel plate detector potential of 1600 V. In order to achieve efficient fragmentation to aid during identification, data were collected using collision energy ramp of 10–30 eV and, when necessary, a higher

collision energy ramp of 165–60 eV was also used. Unless stated, otherwise only ESI negative data are reported herein.

RESULTS EXTRACTION IN PETROLEUM ETHER, ACETONE AND ETHANOL

On the basis of observed result the Petroleum ether extract yield 36.0% and Acetone extract yield 34% and Ethanol 32% and water in 18% (Fig.1)

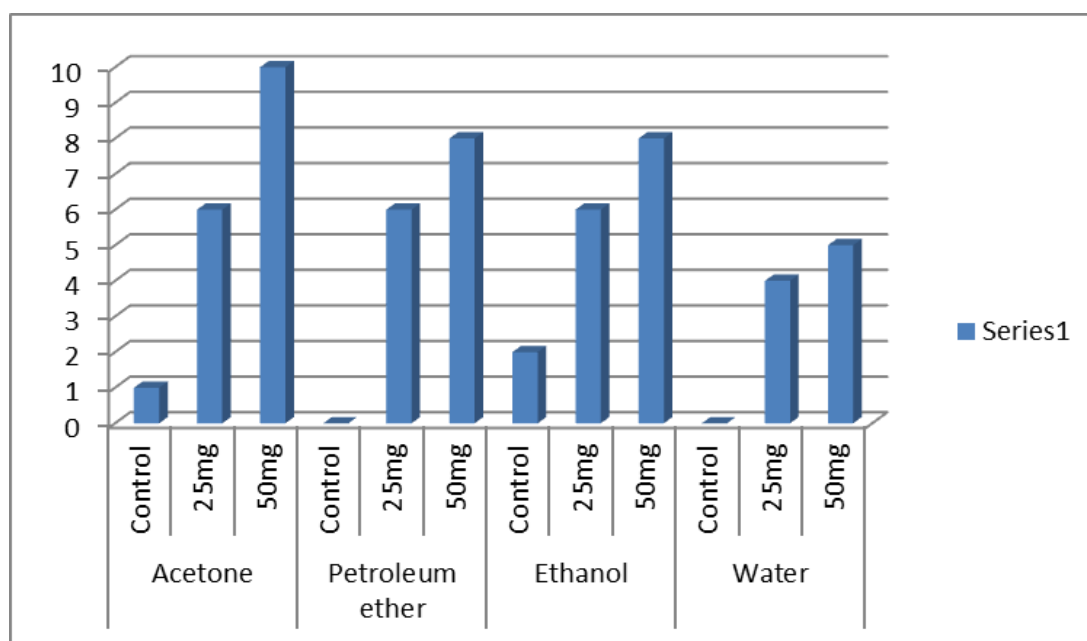


The various extract from the fruits of *S. torvum* was assayed for its antimicrobial activity against, *Escherichia coli*, *Staphylococcus* pathogens by disc diffusion method, measuring the diameter of the inhibition zone with 25, 50, mg of plant extract. The result showed that the plant extract possesses antibacterial activity tested against the bacterial strains. The maximum inhibition was observed at 50 mg concentration against *E. coli*, *S. aureus* and *Staphylococcus sp.* The results indicated that among all the tested extracts, only the Petroleum ether and Acetone exhibited effective antibacterial activity against.

Water and other extract are potent against both pathogens (Inhibition zone diameters between 4 and 12 mm). In general all the pure strains of microorganism were not susceptible to the Acetone and petroleum ether extract of *S. torvum* fruit. The tested extracts showed comparable MIC values with standard antibiotics which ranged from 11.7-20 µg mL⁻¹. Thus the extracts were as potent as standard antibiotics in inhibiting the growth of bacterial strains.

Table: Antimicrobial activity against *E. coli*.

Treatment		Conc. (mgm)	Treatment (mm)		
			Replicates		
			Plate-1	Plate-2	Plate-3
<i>S. torvum</i> extract with	Acetone	Control	2	0	2
		25	6	8	5
		50	10	12	10
	petroleum ether	Con	0	0	0
		25	6	5	7
		50	10	7	8
	Ethanol	Con	2	2	2
		25	6	7	6
		50	8	10	6
	cold water	Con	0	0	0
		25	3	5	4
		50	6	5	6

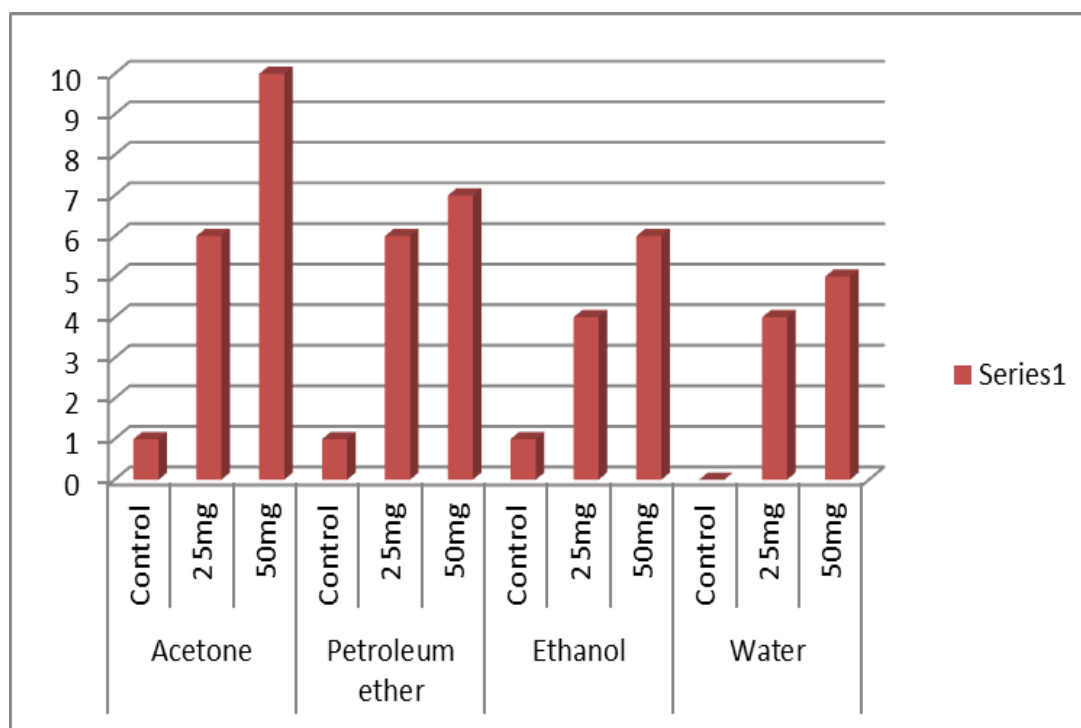


Each value mean of triplicate

Table: Antimicrobial activity against *Staphylococcus aureus*.

Treatment		Conc. (mgm)	Treatment (mm)		
			Replicates		
			Plate-1	Plate-2	Plate-3
<i>S. torvum</i> extract with	Acetone	Control	2	0	2
		25	7	6	5
		50	12	10	9

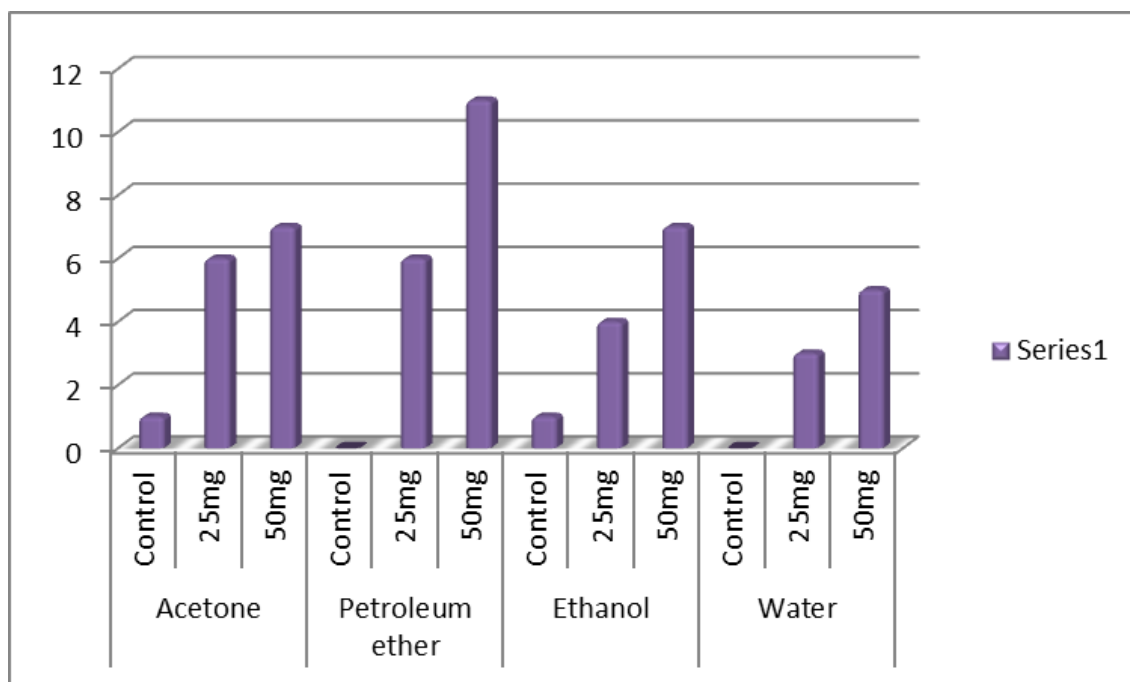
	petroleum ether	Con	0	0	1
		25	5	7	6
		50	8	6	7
	Ethanol	Con	1	2	1
		25	4	4	6
		50	7	6	5
	cold water	Con	0	0	0
		25	3	4	4
		50	5	4	5



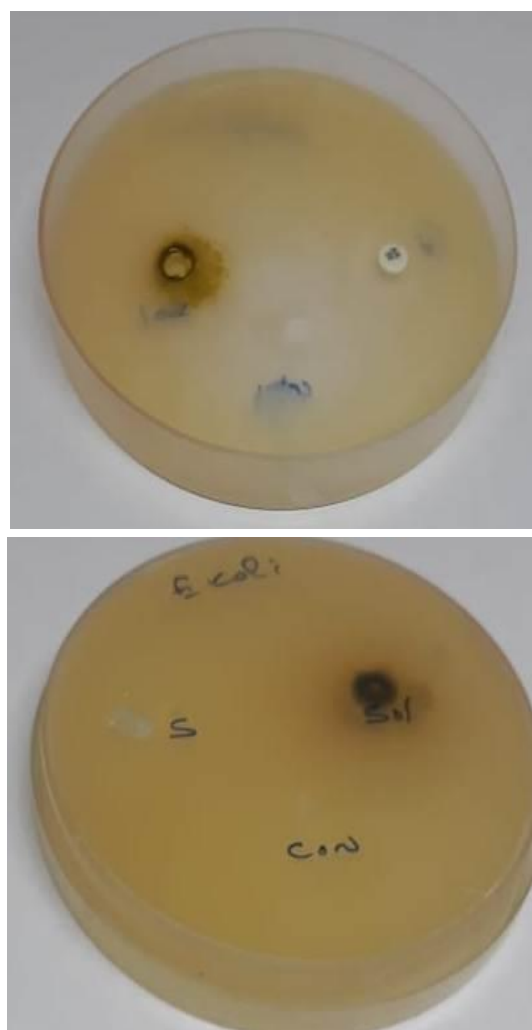
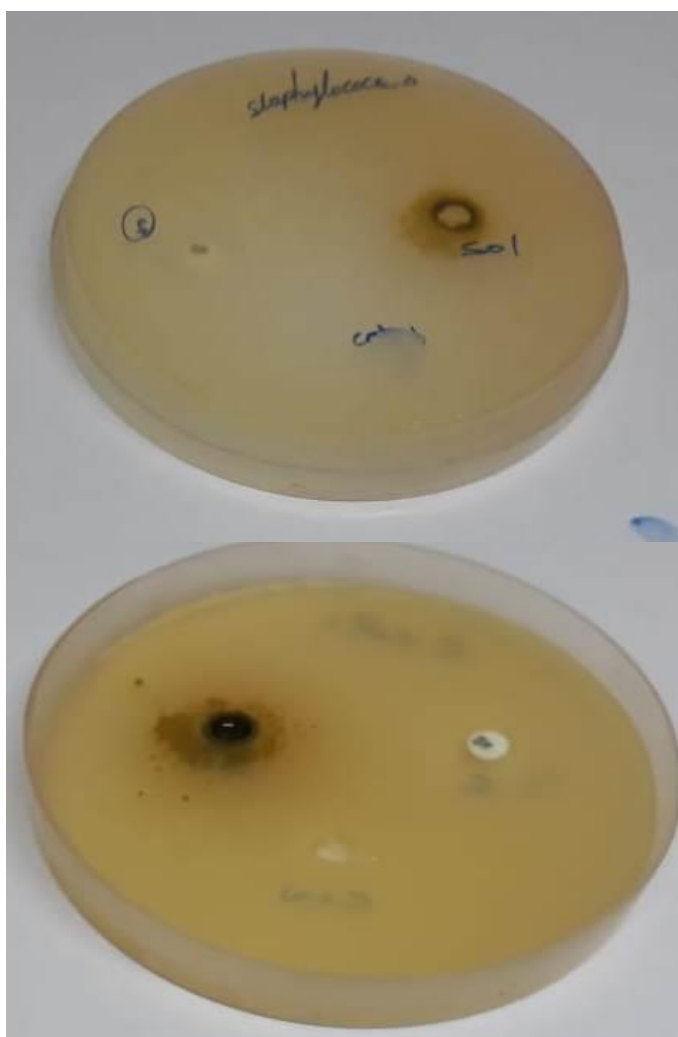
Each value mean of triplicate

Table: Antimicrobial activity against *Streptococcus* sp.

Treatment		Conc. (mgm)	Treatment (mm)		
			Replicates		
			Plate-1	Plate-2	Plate-3
<i>S. torvum</i> extract with	Acetone	Control	1	1	1
		25	6	8	6
		50	8	7	8
	petroleum ether	Con	0	0	1
		25	6	5	6
		50	12	11	10
	Ethanol	Con	1	1	1
		25	5	5	4
		50	8	6	7
	cold water	Con	0	0	0
		25	2	4	3
		50	4	6	5



Each value mean of triplicate





Biochemical Analysis

Orange brown colour precipitate was obtained in dragendroff and yellow precipitate was in Mayer test in all extracts and it confirmed *S. torvum* has Alkaloids. Deep black colour reflects the presence of Tannins and Phenolic ompounds in *S. torvum*. In Molish's test violet colour appeared in acetone extract and results revealed that the carbohydrate is available in *S. torvum*. In Shinoda and Alkaline reagent test yellow colour precipitate was presented in Acetone extract and results exposed that the flavonoids availability. Purple colour formed in Ninhydrin test and dark colour precipitate presence in acetone extract only and its indicated the presence of aminoacids in acetone extract. In Libermann-burchard test was not formed greenish yellow fluorescence in three extracts, revealed that steroids are not available in *S. torvum*. Borntrager's test resulted glycosides available in *S. torvum* because pink colour presence in ethanol extract. Foam was not formed in three extract indicated the absence of saponin glycosides. Appearance of pink color was in Petroleum ether extract only. It indicated the presence of Terpenoids in *S. torvum*.

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Table: Phytochemical Analysis of *S. torvum* fruit extracts.

S. No	Constituents	Pet. Ether	Acetone	Ethanol
1.	Alkaloids	+	+	+
2.	Carbohydrates	-	+	-
3.	Tannins and Phenolic compounds	+	+	+
4.	Amino acids	-	+	-
5.	Fixed oils	-	+	+
6.	Flavonoids	-	+	+
7.	Steroids	-	-	-
8.	Glycosides	-	-	+
9.	Saponin glycosides	-	-	-
10.	Triterpenoids	+	-	-

Thin layer chromatography

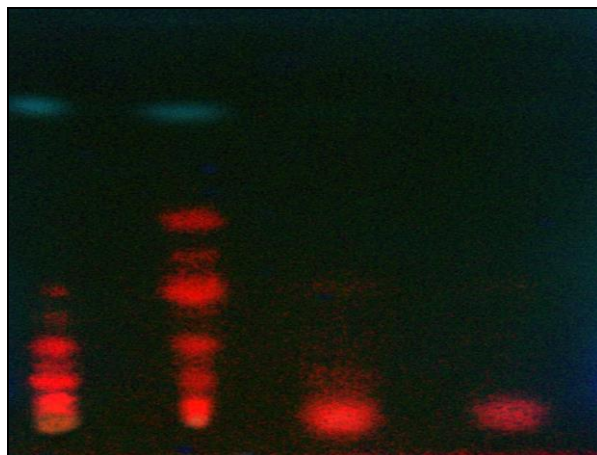
The crude extracts of *S. torvum* were spotted in TLC plate and checked for the presence of ice blue spot. TLC plate was viewed under and iodine chamber. Acetone

fractions of *S. torvum* were selected for further purification (TLC) based on the bioassay results. TLC of 3 fractions of *S. torvum* was spotted in analytical TLC.

The fraction 1 showed the presence of ice – blue spot under UV 365 nm.

i) Fraction in Acetone crude extract; ii) Fraction in purified methanol extract; iii) Fraction in acetone

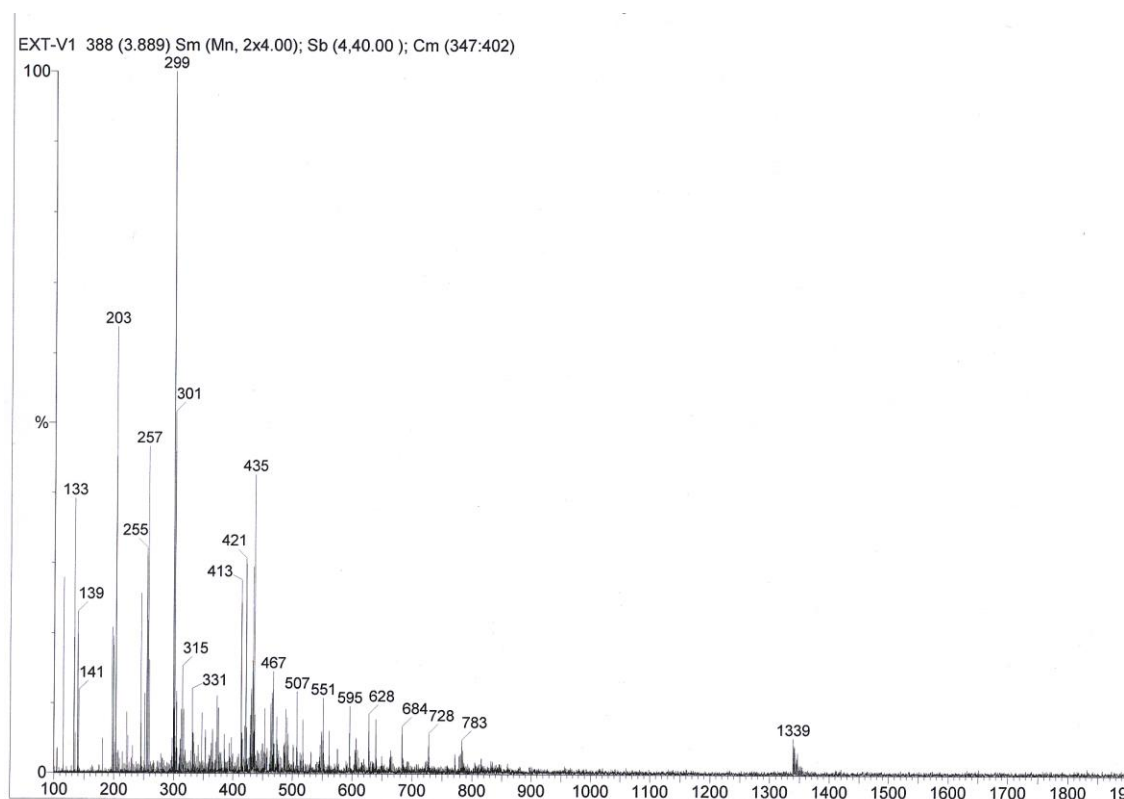
crude extract; iv) Fraction in water extract 3; ice-blue spot (arrow) evidence of active compound



Mass spectrum (Electro-spray ionization mass spectrum -ESIMS)

The ESIMS showed the molecular ion $[M]^+$ 576 and the fragment ions $[M-CH_3]^+$ 561 and $[M-COCH_3]^+$ 533 (Fig. 21). The acetone extract of *Solanum torvum* generated

using the aqueous acetone resulted in very similar phytochemical composition (Figure). A total of 30 metabolites were reported, and these may include chlorogenic acids (CGAs), flavonoids, and alkaloids as shown in Graph.



DISCUSSION

One of the previous studies showed the antimicrobial compounds in ethylacetate extract from *Solanum torvum* especially towards *Pseudomonas aeruginosa*. Nosocomial infections caused by these gram negative bacteria are amongst the most difficult to treat with

conventional antibiotics (Levinson, W.E. and E. Jawetz, 1996, Gilbert, P. and McBain. A.J 2003) and its thus possible that these plants may yield drugs that could improve the treatment of infections caused by the microorganisms.

The phytochemical analysis with the ethanolic extracts of the dried fruit of plant *S. torvum* showed the presence of alkaloids, saponin, sterols, Steroids, terpenoids, protein and amino acid, tannins, carbohydrate. Polyphenols and flavonoids are reported to be important antimicrobial components (Chung et al., 1998; Karou et al., 2005). There are also enough documented date, which suggests that there is a positive correlation between total phenolic content and antimicrobial activity (Shan et al., 2007; Wu et al., 2006; Kudo et al., 2004). Flavonoids isolated from the leaves of *Pluchea carolinensis* has shown antibacterial activity (Cordova et al., 2006). The antibacterial activity of flavonoids and polyphenolic compounds might be due to their ability to complex with bacterial cell wall and therefore, inhibiting the microbial growth.

In order to ascertain the components responsible for antibacterial activity, appeared that Water Extract (WE) and Acetone Extract (EWE) (1:1) of coat had the highest content of polyphenols and flavonoids, in comparison to that of acetone and hexane extract. Considerable amount of α -tocopherol was present in all the extracts where as protein, sugars and ascorbic acid was in negligible amounts. It was interesting to observe that there is a correlation between the high amount of polyphenols and flavonoids content and effective antibacterial activities of Water extract and Ethanol water extract. Therefore it can be concluded that the antibacterial activity may be due to the presence of high concentration of polyphenols and flavonoids of the inhibiting extract.

The minimum inhibitory concentration (MIC) of the methanolic crude extracts of roots of *S. torvum* were determined against *B. cereus*, *B. subtilis*, *Streptococcus- β -haemolyticus*, *S. typhi* and *Sh. dysenteriae* using by a serial tube dilution technique (Bari et al 2015)

CONCLUSION

Medicinal Plant in plant kingdom are the important source of drug and plays a great role for the health of individual and communities. Many plants have been tested for the presence of compounds with therapeutic activity. Therefore, it is necessary to evaluate the antimicrobial activity of *Solanum torvum*.

The extracts of *S. torvum* (Sundakai) fruit coat exhibit significant antibacterial activity against pathogenic bacteria. The extracts showed that high polyphenols and flavonoids content. Therefore this *S. torvum* coat may be yet another source of natural antibiotic. This study clearly shows that rein firms the Ethno medicinal property of *S. torvum*.

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